Relationships Among Soil Temperature, Vegetation, Aspect, and Elevation in the Western Part of Fresno County, California, USA

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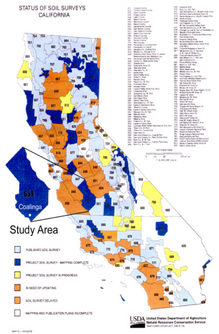


Introduction

Soil temperature is an important property of the soil and, hence, an integral part of Soil Taxonomy. Accurately defining relationships among soil temperature, vegetation, aspect, and elevation are vital to the production of a high quality soil survey. The purpose of this study is to build a model for soil temperature in the Coastal Range of California. Before this investigation, most soils were assumed to have a thermic soil temperature regime, regardless of elevation, aspect, or vegetation. The study area is located in western Fresno County and is characterized by north to northwesterly parallel mountains and intervening valleys of the California Coastal Range. Elevation ranges from about 152 to 1524 m, and the precipitation ranges from 18 to 51 cm.

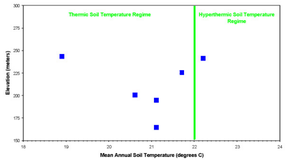
Methods

Sites were selected to represent different aspects, vegetation types, and elevations. Twenty-three sites were monitored for 2 years. Soil temperature was measured at each site by augering a hole and manually measuring the soil temperature at a depth of 50 cm, 4 times a year. Each of the 23 sites is in one of the following 4 groupings.

1. Easterly aspects (45 to 135 degrees azimuth), 165 to 244 m elevation
2. Northerly aspects (315 to 45 degrees azimuth), 341 to 585 m elevation
3. Southerly aspects (135 to 225 degrees azimuth), 530 to 1329 m elevation
4. Northerly aspects (315 to 45 degrees azimuth), 732 to 1372 m elevation

Results and Discussion

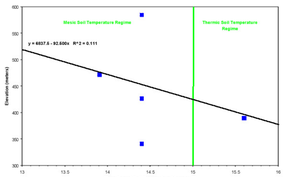
Easterly Aspects: 45 - 135 degrees azimuth
(165 - 244 meters) elevation



Sites in this group include terraces and low hills vegetated with annual grasses, saltbush (*Atriplex* spp.), red brome (*Bromus rubens*), and filaree (*Erodium cicutarium*). No trees grow on these soils.

The data indicate that the soil temperature at these sites is the upper end of thermic, averaging between 19ºC and 21ºC. Before this study, soil scientists considered these areas as thermic, but did not realize that they bordered hyperthermic. Associated soils include Haplocambids, Natrargids, Haplargids, and Torriorthents.

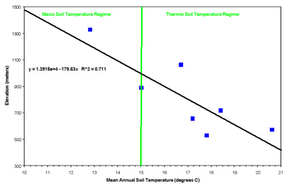
Northerly Aspects: 315 - 45 degrees azimuth
(341 - 585 meters) elevation



This group includes hills with differences in aspect reflected in the vegetation and soils. California juniper (*Juniperus californica*) dominates the lower elevations in this group. Blue oak (*Quercus douglasii*) and grey pine (*Pinus sabiniana*) increase in both amount and size with increases in elevation. The understory is dominated by grasses, forbs, and shrubs such as red brome (*Bromus rubens*), soft chess (*Bromus mollis*), filaree (*Erodium cicutarium*), and goldenbush (*Haplopappus* spp.).

The soil temperature data for these sites averages about 14ºC, which is the upper end of mesic. Before soil temperature monitoring, these areas were considered to have a thermic soil temperature regime. Dominant soils include Argixerolls with weakly expressed mollic epipedons and argillic horizons.

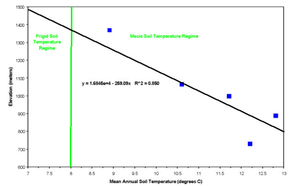
Southerly Aspects: 135 - 225 degrees azimuth
(530 - 1329 meters) elevation



This group includes hills and mountains with differences in aspect reflected in the vegetation and soils. The vegetation on these southerly aspects is generally without trees except for an occasional California Juniper (*Juniperus californica*). Vegetation species is dominated by chaparral species such as chamise (*Adenstoma fasciculatum*), buckwheat (*Eriogonum* spp.), and yucca (*Yucca* spp.).

The temperature data for these sites averages about 17ºC. Previously these areas were considered to have a thermic soil temperature regime. The southerly aspects are dominated by Xerorthents and Haploxerepts.

Northerly Aspects: 315 - 45 degrees azimuth
(333 - 1321 meters) elevation



This group includes mountains with distinct differences in aspect that are reflected in the vegetation and soils. The vegetation on the northerly aspects is dominated by tree species that include grey pine (*Pinus sabiniana*), Coulter pine (*Pinus coulterii*), jeffery pine (*Pinus jeffreyi*), and blue oak (*Quercus douglasii*). The understory includes buckbrush (*Ceanothus* spp.), manzanita (*Arctostaphylos* spp.), soft chess (*Bromus mollis*), and pine bluegrass (*Poa scabrella*).

The soil temperature data at these sites ranges from 10.6 to 12.8ºC, well within the range for mesic (8 to 15ºC). Before this study, many of these areas were mapped in a thermic soil temperature regime. The dominant soils on the northerly aspects are deep Argixerolls with well-developed mollic epipedons and argillic horizons.

Summary

Previously, most soils in the Coastal Range of California were considered to have a thermic soil temperature regime. This study demonstrates that soils with a northerly aspect have a mesic soil temperature regime, while soils with southerly and easterly aspects have a thermic soil temperature. The different aspects have unique plant communities and associated soils that are readily recognized and easily mapped. The information from this investigation can be interpolated to other parts of the Coastal Range of California to build a more accurate model for making soil surveys.

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SOIL SURVEY
1899 1999
CENTENNIAL

Easterly Aspect (165 - 244 m)

Location: Alcalde Hills about 3 kilometers southwest of Coalinga, CA

Site Data: 242 m elevation on a southeast aspect with 32 percent slope

Dominant Vegetation: Saltbush (*Atriplex* spp.); Filaree (*Erodium cicutarium*); Red Brome (*Bromus rubens*)

Soil Name: Guijarral gravelly sandy loam (taxadjunct)

Classification: coarse-loamy, mixed, superactive, hyperthermic Typic Haplocambids

Mean Annual Soil Temperature: 22.2°C; Hyperthermic Temperature Regime (close to Thermic)

Remarks: This site has the highest soil temperature recorded on the soil survey of the western part of Fresno County, CA. Soil surveys in California classify similar soils with this vegetation exclusively in the thermic temperature regime. Site number 11.

Northerly Aspect (341 - 585 m)

Location: Curry Mountain about 8 kilometers southwest of Coalinga, CA

Site Data: 341 m elevation on a northwest aspect with 53 percent slope

Dominant Vegetation: Blue Oak (*Quercus douglasii*); California Juniper (*Juniperus californica*); Goldenbush (*Haplopappus* spp.); Filaree (*Erodium cicutarium*); Red Brome (*Bromus rubens*)

Soil Name: Currymountain loam

Classification: fine-loamy, mixed, superactive, mesic Typic Argixerolls

Mean Annual Soil Temperature: 14.4°C; Mesic Temperature Regime

Remarks: Soil, vegetation, and Mean Annual Soil Temperature (upper mesic) on north aspects at elevations of about 305 to 427 m. Site number 12.

Southerly Aspect (530 - 1329 m)

Location: California Coast Range near Coalinga Mineral Springs, about 16 kilometers west of Coalinga, CA

Site Data: 573 m elevation on a south aspect with 60 percent slope

Dominant Vegetation: Buckwheat (*Eriogonum* spp.); Yucca (*Yucca* spp.); Filaree (*Erodium cicutarium*); Ripgut Brome (*Bromus rigidus*)

Soil Name: Wisflat sandy loam

Classification: loamy, mixed, superactive, calcareous, thermic Lithic Xerorthents

Mean Annual Soil Temperature: 20.6°C; Thermic Temperature Regime

Remarks: This soil is on mixed sandstone and conglomerate. The Mean Annual Soil Temperature is 6.2°C higher than a site located 200 m away on a north aspect. Site number 18.

Northerly Aspect (341 - 585 m)

Location: California Coast Range near Coalinga Mineral Springs, about 16 kilometers west of Coalinga, CA

Site Data: 585 m elevation on a north aspect with 75 percent slope

Dominant Vegetation: Blue Oak (*Quercus douglasii*); Digger Pine (*Pinus sabiniana*); Poison Oak (*Rhus diversiloba*)

Soil Name: Currymountain taxadjunct

Classification: loamy-skeletal, mixed, superactive, mesic Typic Argixerolls

Mean Annual Soil Temperature: 14.4°C; Mesic Temperature Regime

Remarks: This soil is on a conglomerate. The Mean Annual Soil Temperature is 6.2°C lower than a site located 200 m away on a south aspect. Site number 19.

Northerly Aspect (732 - 1372 m)

Location: California Coast Range southwest of Spanish Lake on Joaquin Ridge about 23 kilometers northwest of Coalinga, CA

Site Data: 1372 m elevation on a north aspect with 48 percent slope

Dominant Vegetation: Leather Oak (*Quercus durata*); Coulter Pine (*Pinus coulterii*); Grey Pine (*Pinus sabiniana*); Buckbrush (*Ceanothus* spp.); Manzanita (*Arctostaphylos* spp.)

Soil Name: Atravesada sandy loam

Classification: loamy, magnesic, mesic, shallow Typic Argixerolls

Mean Annual Soil Temperature: 8.9°C; Mesic Temperature Regime

Remarks: Soil formed in serpentinite and asbestos bedrock. Site number 24.

Northerly Aspect (732 - 1372 m)

Location: California Coast Range near the boundary between Fresno, Monterey, and San Benito Counties

Site Data: 890 m elevation on a north aspect with 31 percent slope

Dominant Vegetation: Grey Pine (*Pinus sabiniana*); Blue Oak (*Quercus douglasii*); Mountain Mahogany (*Cercocarpus betuloides*); Soft Chess (*Bromis mollis*); Pine Bluegrass (*Poa scabrella*)

Soil Name: Roacha silty clay loam

Classification: fine, smectitic, mesic Typic Argixerolls

Mean Annual Soil Temperature: 12.8°C; Mesic Temperature Regime

Remarks: The Mean Annual Soil Temperature is 2.2°C lower than a site located 200 m away on a south aspect. Soil, vegetation, and Mean Annual Soil Temperature are typical of soils in the California Coast Range on north aspects at elevations greater than 610 m. Site number 9.

Southerly Aspect (530 - 1329 m)

Location: California Coast Range near the boundary between Fresno, Monterey, and San Benito Counties

Site Data: 890 m elevation on a south aspect with 15 percent slope

Dominant Vegetation: Pine Bluegrass (*Poa scabrella*); Wild Oat (*Avena fatua*)

Soil Name: Altamont clay

Classification: fine, smectitic, thermic Aridic Haploxererts

Mean Annual Soil Temperature: 15°C; Thermic Temperature Regime

Remarks: The Mean Annual Soil Temperature is 2.2°C higher than a site located 200 m away on a north aspect. Grassy area in the foreground is Altamont soil. There is little canopy for shade and the soil cracks reduce the ability of the soil to buffer temperature change. Site number 10.